NEW LAND SNAILS FROM BOGGOMOSS ENVIRONMENTS IN THE DAWSON VALLEY, SOUTHEASTERN QUEENSLAND (EUPULMONATA: CHAROPIDAE AND CAMAENIDAE)

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Land snails, *Elsothera hewittorum* sp. nov. (Charopidae) and *Adclarkia dawsonensis* gen. et sp. nov. (Camenidae) are described from on and near mound spring environments in the Dawson Valley, southeastern Queensland. These mound springs, locally known as boggomosses, are significant perennially moist habitats, in a predominantly dry environment. Relationships and biogeographic significance of the species are assessed. The roles of the Dawson Valley and the scattered mesic habitats occurring there are examined in regard to past episodes of land snail migration. It is concluded that the boggomosses are central to dispersal of wet-adapted biota in the region. □ *Mollusca, Eupulmonata, Charopidae, Camaenidae, biogeography, boggomosses.*

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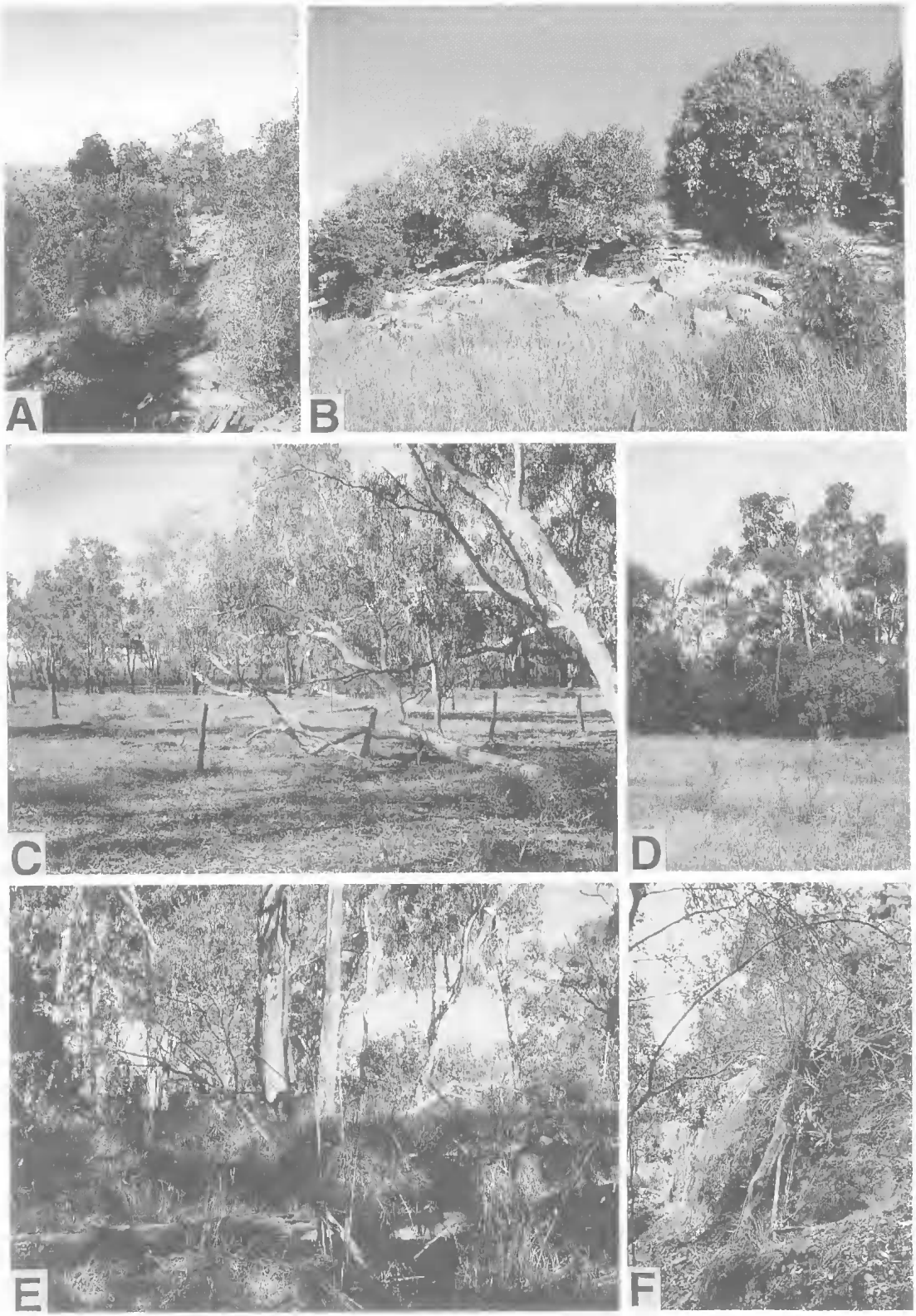
The Dawson Valley, southeastern Queensland (SEQ) is located in relatively snail-poor countryside.The microphyll vine forests and semi-evergreen vine thickets of the coastal and sub-coastal ranges to the east support some of the richest land snail communities of eastern Australia with up to 40 species recorded at several sites (Stanisic,1994). However, in southern Queensland land snail diversity decreases rapidly with increased distance from the coast and sites within the Dawson Valley support <10 species.

Climate of the Dawson Valley is sub-humid, being transitional between the eastern humid and western semi-arid regions (Nix,1977). Rainfall is 600-700mm annually and mesic refugia which are liable to support land snails are scarce. Much of the Dawson Valley has been cleared for cultivation and grazing. In the remaining natural areas, dry open forest and woodland communities, dominated by *Acacia harpophylla* (brigalow), are conspicuous (Johnson,1984) (Fig. 1C,D). Highly developed rainforest does not occur, but semi-evergreen vine thicket characterised by *Brachychiton rupestre*, is sparsely scattered in the region (Speck,1968). This vegetation community is usually found on basalt-derived brown and grey-brown loams and clays. Besides well-drained soils, vine thickets also favour the limited rocky outcrops in the area (Fig. 1A,B). These outcrops act as moisture reservoirs and provide protection from fires. Other moist microhabitats are found along drainage lines (Fig. 1F) where weathered alluvium and outcropping Tertiary rocks furnish suitable conditions for the maintenance of small discontinuous pockets of 'rainforest-derived' flora (pers. obs.). In this context new land snails on and around the boggomoss on Mount Rose Station (Fig. 1E), NE of Taroom, Dawson Valley raise interesting questions on significance of scattered mesic refugia to land snail survival in marginally dry areas.

BOGGOMOSSES

The boggomosses are a series of small, elevated peat bogs or swamps scattered among the woodland communities near Taroom, on the Dawson River. They are fed by mound springs which are leakages from aquifers of the Great Artesian Basin (Wilson,1995). Water forces its way to the surface through faults in the underlying sandstone. Where this water percolates above the ground a unique mesic habitat is formed. Sedges, tall grasses and ferns form a green ground-carpet of vegetation; sometimes an understorey of smaller trees is developed. Large gums are a feature. In many cases the dominant large tree species is *Eucalyptus coolabah* (coolibah) whose size and shallow root system combined with the soft, moist substrate in which it lives, makes it vulnerable to wind damage. Thus a feature of the boggomosses is a large amount of ground-strewn, branch and whole tree debris which provides a diverse array of litter-zone microhabitats. Although a number of the boggomosses have been degraded to varying degrees by stock, and in some instances fire, they are still significant habitats for moisture loving biota.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SYSTEMATICS

Class GASTROPODA
Order EUPULMONATA
Suborder STYLOMMATOPHORA
Family CHAROPIDAE

Elsothera Iredale,1933

Elsothera Iredale,1933:53; Iredale,1937a:324 Iredale, 1937b: 24; Stanisic,1990:160; Smith,1992:187.
TYPE SPECIES. *Helix sericatula* Pfeiffer,1850; by original designation.

REMARKS. *Elsothera* is characterised by species which have strongly, radially ribbed , brown to greyish shells (often with darker periostracal streaks) , with or without an umbilicus and with a protoconch that has predominantly radial ribs and low, moderately spaced spiral cords. The complex vas deferens/ epiphallus junction, expanded vas deferens and penis with very enlarged apical bulb and reduced sheath is a combination of characters peculiar to *Elsothera* sensu Stanisic,1990. *Elsothera* previously extended from SE S AUST into N NSW. The new species significantly extends the range of the genus. As presently understood, it is probably the most ecologically diverse genus of the Charopidae, inhabiting rainforest, wet and dry sclerophyll forest, and woodland.

Elsothera hewittorum sp. nov.
(Figs 2A-C; 3A-F; 4A-D)

ETYMOLOGY. For the Hewitt family, owners of Mount Rose Station, Taroom.
MATERIAL EXAMINED. HOLOTYPE QMMO56283, Taroom, c.45km NE on Mt Rose Stn, SEQ (25°27'15"S,150°01'15"E), under log beside boggomoss, woodland. Collected J.Stanisic, 23 May 1995. Height of shell 2.52mm, diameter 5.21mm, H\D ratio 0.51, D\U ratio 3.49, whorls 4 3\4. PARATYPES QMMO56281, 6 specimens, same data as holotype.

DESCRIPTION. Shell (Fig. 2) small, diameter 4.87-5.29mm (mean 5.06mm) with 4 1/2-5 (mean 4 3/4) evenly coiled whorls. Apex and spire slightly elevated, height of shell 2.27-2.94mm (mean 2.57mm), SP\BWW ratio 0.10-0.20 (mean 0.13),H/D ratio 0.47-0.61 (mean 0.51).

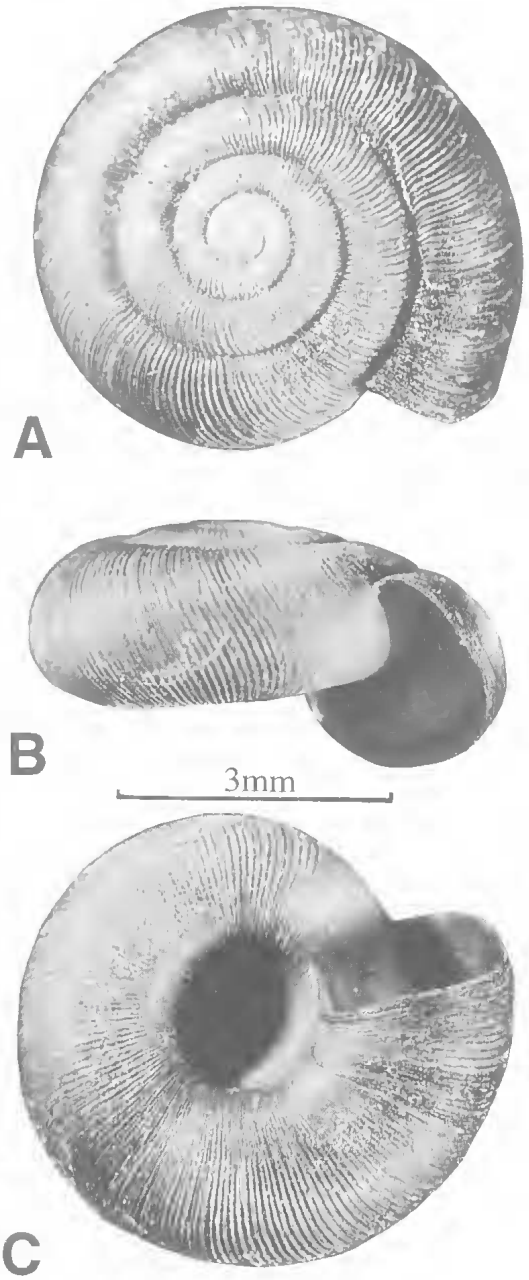


Fig. 2. A-C, holotype of *Elsothera hewittorum* sp. nov., QMMO56283, Mt Rose Stn. Scale line=3mm.

FIG. 1. Vegetation communities in the Taroom area, Dawson Valley, SEQ. A,B, vine thicket on rocky outcrop, Mt Rose Stn; C, open woodland, Boggomoss Stn; D, brigalow\eucalypt association, Boggomoss Stn; E, boggomoss, Mt Rose Stn, the type locality of *Adclarkia dawsonensis* sp. nov.; F, remnant vine thicket along edges of Cabbage Tree Creek, near Taroom.

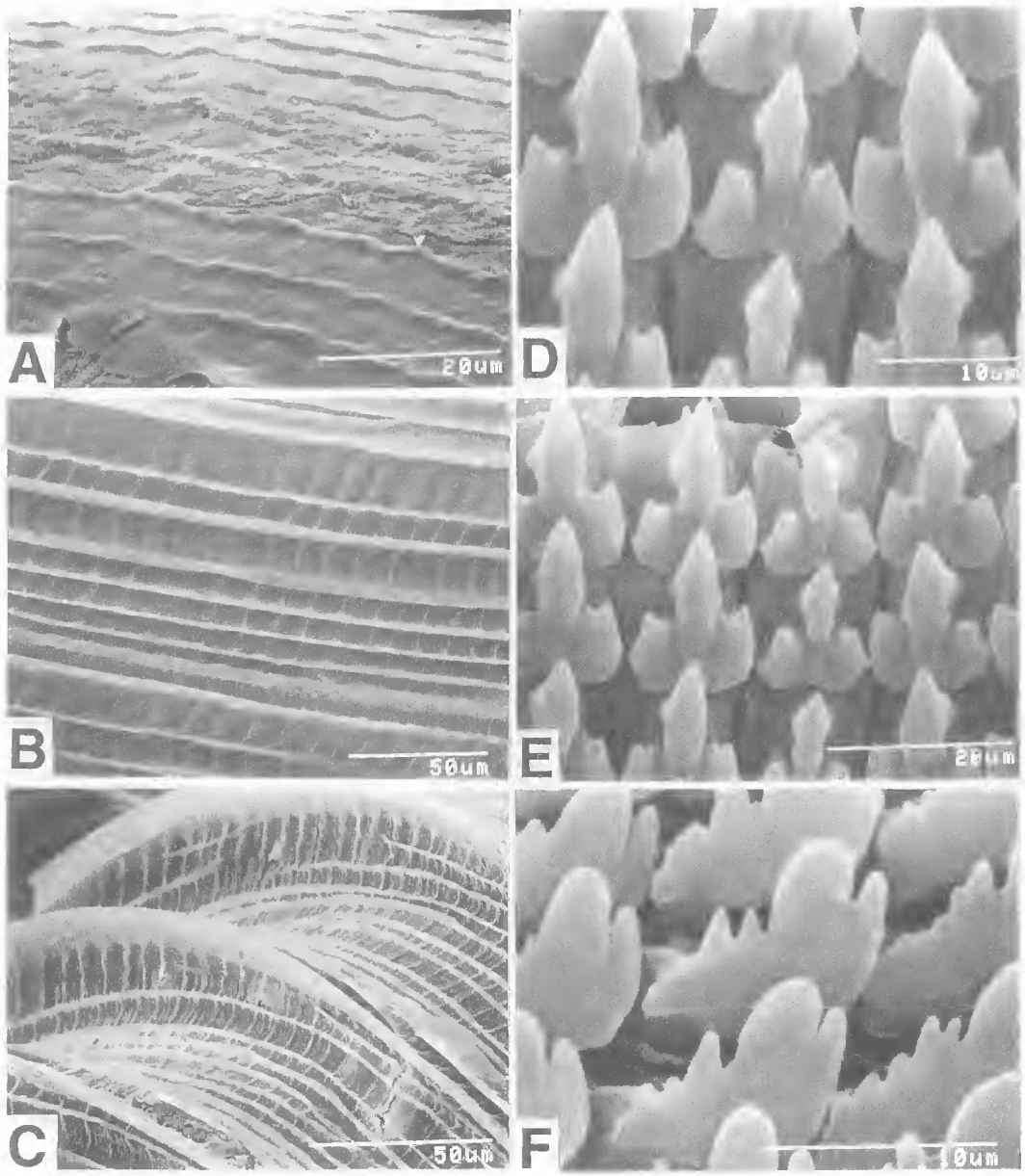


FIG. 3. Shell and radular details of *Elsothera hewittorum* sp. nov. , QMMO56283, holotype, Mt Rose Stn. A, apical sculpture. B, body whorl sculpture. C, close-up of a major rib to show extent of microsculpture. D,E, central and inner lateral teeth. F, marginal teeth. Scale lines as marked.

Protoconch somewhat dull, of 1 1/4 whorls, approximate width 620(m. Apical sculpture (Fig. 3A) of evenly and moderately spaced, fine wavy, spiral cords and weak, slightly curved low radial ridges, mainly on the second half of the protoconch, becoming more pronounced toward the protoconch-teleoconch boundary. Postnuclear sculpture (Fig. 3B) of crowded, prominent, weakly protractively sinuated radial ribs, each with a well developed periostracal blade. Ribs on body whorl 144-176 (mean 157). Microsculpture (Fig. 3B) of fine radial riblets, 4-8 between each pair of major ribs, and fine, crowded spiral cords; microsculpture continuous on major ribs (Fig. 3C). Umbilicus wide, deep cup-shaped, diameter 1.29-1.64 (mean 1.46mm), D/U ratio

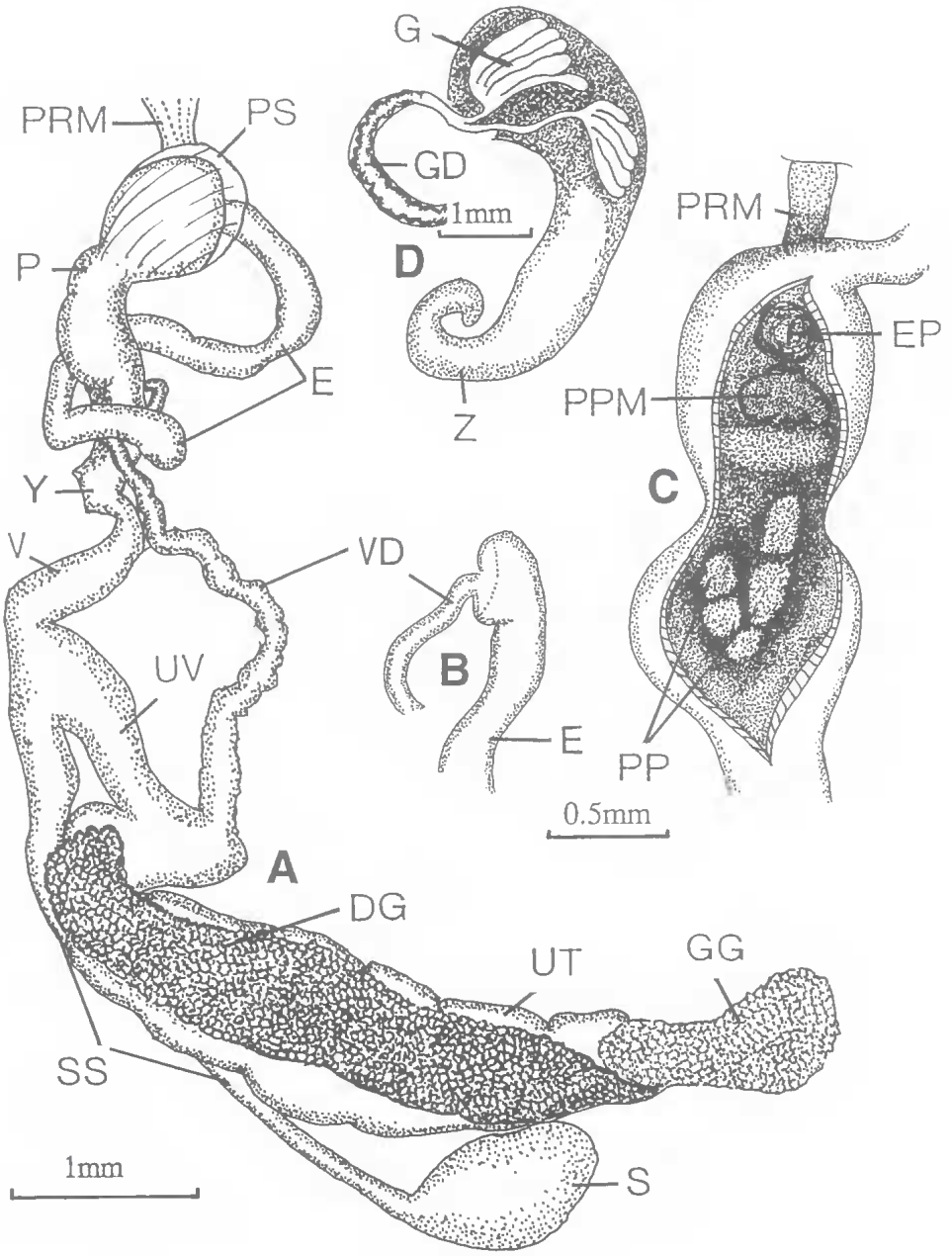


FIG. 4. Reproductive anatomy of *Elsothera hewittorum* sp. nov. , QMMO56283, holotype, Mt Rose Stn. A, reproductive system.B, vas deferens-epiphallus junction. C, penis interior. D, ovotestis. Abbreviations outlined in text. Seale lines as shown.

3.19-3.78 (mean 3.49). Sutures impressed,becoming more so as the last whorl slowly descends. Aperture subcircular, lip simple. Colour of shell greyish-brown with occasional darker periostracal streaks. Based on 5 measured specimens (QMMO56281, QMMO56283).

Penis (P) (Fig. 4A) relatively long, with a prominent apical bulb. Penial sheath (PS) only in the bulb region. Penis internally (Fig.4C) with a

series of low spongy thickenings distally (PPS) and a prominent fleshy, irregularly shaped pilaster proximally (PPM); basal region of penial chamber separated from apical region by a low circular collar-like thickening. Epiphallus (E) long,muscular and twisted about the penis, internally with longitudinal thickenings, entering penis apically through a simple pore (EP). Penial retractor muscle (PRM) attached to penial bulb adjacent to the penis-epiphallus junction. Vas deferens (VD) initially an expanded tube with prominent glandular walls, descending to the peni-oviducal angle, then ascending and twisting about the penis prior to becoming a thin tube and entering the epiphallus through a fleshy, circular collar (Fig.3B). Vagina (V) c.1/2 the length of the penis. Free oviduct (UV) large, swollen. Prostate-uterus (DG\UT) without unusual features. Atrium (Y) short. Spermatheca (S) with an enlarged base, long and thin stalk (SS) and large, ovate head appressed to the surface of the albumen gland (GG). Hermaphroditic duct (GD) typical. Ovotestis (G) (Fig. 3D) two clumps of finger-like alveoli oriented parallel to the plane of coiling and embedded in the apical whorls of the digestive gland (Z). Animal colour grey. Radula (Fig. 3D-F) with tricuspid central and lateral teeth (central slightly smaller) in which the mesocone is long and lanceolate, ecto- and endocones short and acutely pointed; marginal teeth multicuspid due to ectoconal splitting. Based on one dissected specimen (QMMO56281).

COMPARATIVE REMARKS. *Elsothera hewittorum* sp.nov. resembles *E. funerea* (Cox,1868) from NSW (type locality:Mudgee) and *E. nesana* Iredale,1937 (type locality:Port Lincoln, South Australia). [The latter species was considered a synonym of *E. murrayana* (Pfeiffer, 1864) by Smith (1992) but has a tighter coiling pattern and much finer ribbing]. Compared with *E. funerea, E. hewittorum* is smaller with less elevated spire and apex, has smaller whorls, finer adult ribbing, larger umbilicus and almost obsolete radial ribs on the the protoconch (Fig. 3A). *E. nesana* has similarly disposed radial ribs but has larger whorls,more prominent radial ribs on the protoconch and a basally flattened body whorl. *E. nautilodea* (Cox,1866) and *E. genithecata* Stanisic,1990 from NE NSW are readily distinguished from the new species by their closed umbilici. *E. sericatula* (Pfeiffer,1850) from central coastal NSW has a closed umbilicus and radial ribs on the entire protoconch. *E. murrayana* has more loosely coiled whorls and widely spaced bold radial ribs. The combination of very small, brown shell with dense radial ribbing, slightly raised spire and relatively wide umbilicus distinguishes *E. hewittorum* from other land snails of the Dawson Valley.

RANGE AND HABITAT. Known only from the type locality. More westerly species of this complex (*E.funerea, E.nesana, E.murrayana*) inhabit drier woodland environments with a preference for mesic refuges such as rocky outcrops, particularly limestone (Stanisic unpubl. data). *E.hewittorum* has a similar ecologic preference.

REMARKS. Generic assignment of *E. hewittorum* is based on structural similarity of its reproductive system to that of *Elsothera* by Stanisic (1990). However, the anatomical consistency of species of *Elsothera* (Iredale, 1937a,b; Stanisic,1990; Smith, 1992) underpins a wide variation in shell form. Shell shape has a strong ecological correlation (Solem & Climo, 1985; Stanisic,1990) and the variability in this character in *Elsothera* reflects the diverse ecological preferences of its members. *E. hewittorum* is closest to *E. funerea* and *E. nesana* with which it shares a greyish-brown shell with very open umbilicus and apical sculpture of radial ribs and prominent spiral cords. The three species also live in similar habitats.

Family CAMAENIDAE
Subfamily CAMAENINAE

Adclarkia gen. nov.

ETYMOLOGY. For Adam Clark of Taroom.
TYPE SPECIES. *Adclarkia dawsonensis* sp. nov.

DIAGNOSIS. Shell large, relatively thin, with weakly elevated spire and apex, comparatively small umbilicus and weakly reflected lip. Apical sculpture of scattered subcircular pustules. Adult sculpture of very weak radial growth ridges and moderately spaced elongate pustules ; microsculpture of fine periostracal ridgelets. Genitalia elongate,with a long tubular penis, short epiphallic flagellum and proto-sheath enveloping penis, epiphallus and epiphallic flagellum. Penial retractor muscle inserted on epiphallus. Penis internally with prominent pustules and a wrinkled tubular verge with a terminal pore. Head wart present.

COMPARATIVE REMARKS. The shell of

Adclarkia bears little resemblance to other large Queensland camaenids. The relatively thin, almost monochrome shell is in direct contrast to the larger, striped and solid-shelled camaenids of coastal regions. Taxonomic significance of these external differences is supported by the reproductive anatomy, which in *Adclarkia* has numerous irregularities not seen in moist-forest camaenids further east (Solem, 1992a). In particular the proto-sheath and pattern of penial pustules contrasts with the muscular penial sheath and very complicated penial sculpture in *Sphaerospira* Morch, 1867, *Bentosites* Iredale, 1933 and *Hadra* Albers, 1860. *Meridolum* Iredale, 1942 and *Thersites* Pfeiffer, 1842 (see Solem, 1992a) from coastal regions of southern New South Wales and southern Queensland have a protosheath rather than a prominent penial sheath and pustulose penial wall sculpture. However, the shells of these two genera have different form and microsculpture. Only *M.gilberti* (Pfeiffer, 1846) has shell surface pustules but these are round and crowded and lack the periostracal scales of *A. dawsonensis*. *Galadistes* Iredale, 1938 from inland northern New South Wales and *Pallidelix* Iredale, 1933 from the Expedition Range in southern Queensland have yet to be examined anatomically. These genera have pustules on the adult shell but differ in form (circular) from those of *Adclarkia*. They also have quite different shell shape (globose) and apical sculpture (very crowded pustules).

Cupedora Iredale,1933 from eastern South Australia most resembles *Adclarkia* in anatomy and shell. Both genera have a proto-sheath and similar pustulation in the penis. However, in *Cupedora* the pustulations in the penial chamber are largely confined to the upper half with prominent longitudinal ridges in the lower half. In particular the shell sculpture of *Cupedora* (see Solem, 1992a, pl. 26, figs c,d), apart from the shape of the pustules, is very similar to that of *Adclarkia*. Main differences are the the greater calcification in shells of *Cupedora* and their tendency to have reddish chestnut bands in most cases.

Adclarkia dawsonensis sp. nov.
(Figs 5, 6A-C, 7A-H, 8A-D)

ETYMOLOGY. For the Dawson Valley.

MATERIAL EXAMINED. HOLOTYPE QM MO56284, Taroom, c.45km NE, on Mt Rose Stn, SEQ (25°27'15"S, 150°01'15"E), in litter beneath sandpaper fig on boggomoss. Collected by J. Stanisic, J. Johnson, J. Short, 23 May 1995. Height of shell 14.58mm, diameter 21.68mm, H\D ratio 0.67, D\U ratio 9.86, whorls 5 1/8. PARATYPES QMMO56280, 4 subadults, 12 juveniles, same data as holotype; QMMO4239, 1 adult, Theodore, Dawson Valley, SEQ, under rubbish in damp situation; QMMO6779, 2 adults, Theodore, Dawson Valley, SEQ, in garden crawling after rain, ex S. McKay; QMMO56289,1 adult, 7 juveniles, same locality as holotype, under logs, C. Eddie, 11 July 1995.

FIG. 5. *Adclarkia dawsonensis* sp. nov., QM MO56284, holotype, Mt Rose Stn.

DESCRIPTION. Shell (Fig. 6A-C) comparatively thin, diameter 21.68–25.74mm (mean 23.82mm) with 5 1/8–5 5/8 (mean 5 1/2 whorls. Apex and spire very slightly elevated, height of shell 14.58–16.62mm (mean 15.80mm), H\D ratio 0.65–0.67 (mean 0.67). Apical sculpture (Fig. 7A) of radially disposed, moderately spaced, irregularly elongate pustules. Spire and body whorl with densely scattered, elongate pustules (Fig.7B) and weak, radial growth ridges; in unworn specimens a small periostracal scale sits atop each pustule (Fig. 7C) . Microsculpture of fine, crowded ridgelets (Fig. 7B,C). Shell periphery rounded with last whorl slowly descending. Aperture subcircular. Lip weakly reflected, columellar margin dilated and partially covering the umbilicus. Umbilicus small, width 2.34–3.24mm (mean 2.63mm), D/U 7.15–10.55 (mean 9.26). Shell colour light-brown to greenish-yellow horn, occasionally with a narrow, red subsutural band and a small, red circumumbilical patch; lip white. Based on four measured specimens (QMMO56284, QMMO4239, QMMO6779).

Genitalia (Fig. 8A) with long vagina (V) and short free oviduct (UV). Vagina internally with high, thin, longitudinal pilasters. Spermatheca (S), with stalk swollen basally and head ap-

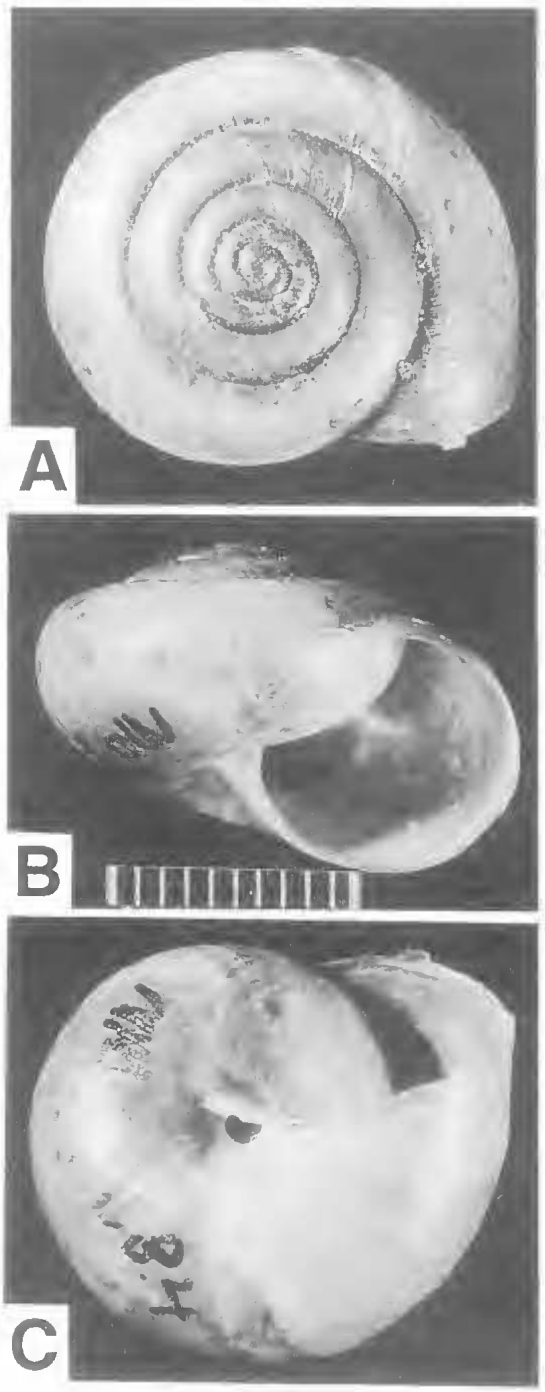
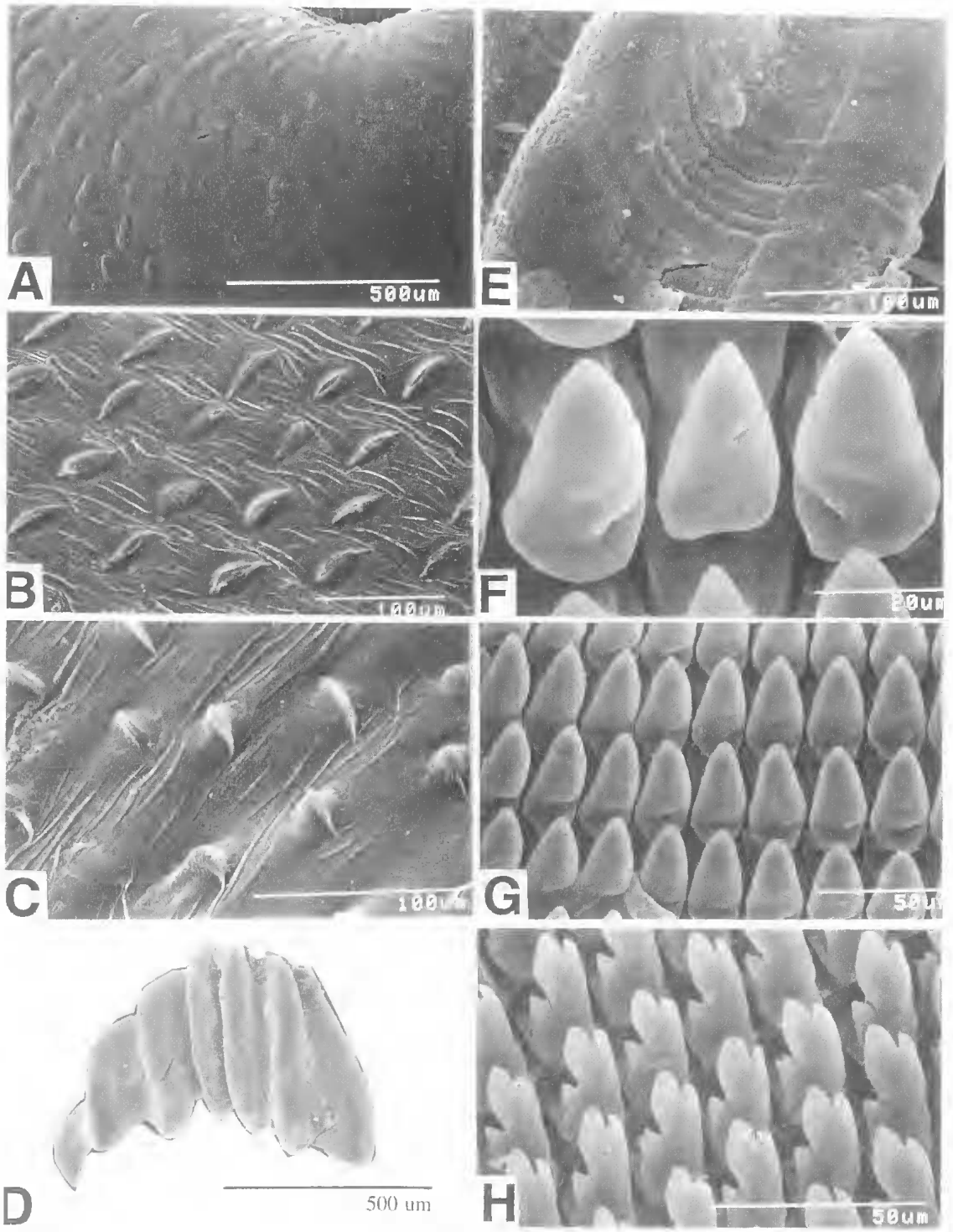


FIG. 6. A-C, Shell of *Adclarkia dawsonensis* sp. nov. QMMO56284, holotype, Mt Rose Stn. Scale in millimetres.

pressed to base of albumen gland (GG). Prostate-uterus (DG\UT) without unusual features. Terminal male genitalia enveloped in a sheath of connective tissue (PS). Penis (P) slightly longer than vagina, muscular; internally (Fig. 8B) with longitudinal rows of elongate pustules (PP) which become more crowded in the lower half of the penis before giving rise to fleshy longitudinal pilasters (PPL) in the lower quarter; apically with a wrinkled, tubular papilla (PV). Epiphallic pore (EP) terminal on the papilla. Epiphallus (E) a reflexed, muscular tube, about half the length of the penis, becoming enlarged about halfway along its length, internally with longitudinal thickenings; a short finger-like flagellum (EF) is located at the epiphallus-vas deferens junction. Vas deferens (VD) a thin tube descending from the prostate-uterus to the peni-oviducal angle, reflexing apicad of the angle. Penial retractor muscle (PRM) inserted on the epiphallus at the point where it reflexes. Talon (GT) short, finger-like, embedded in the surface of the albumen gland. Hermaphroditic duct (GD) weakly convoluted, not swollen. Albumen gland (GG) elongate, rusty-brown. Ovotestis (G) (Fig. 8C) several clumps of long, creamy-coloured, finger-like alveoli, in the apical whorls of the digestive gland (Z). Atrium (Y) without unusual features. Animal colour light brown to white with varying amounts of grey in the neck region, on the sides of the foot and above the tail. Surface of lung-roof and visceral coil with prominent, irregular black pigmentation (Fig. 5). Mantle mustard-orange. Head wart (Fig. 8D) located between the bases of the superior tentacles. Radula (Fig. 7F-H) with basically unicuspid central and lateral teeth, central slightly smaller, with very tiny ectocones situated half-way up the main cusp shaft. Lateral teeth with prominent anterior flare, reduced in central tooth. Lateromarginal teeth tricuspid with endocone located high up on the mesocone. Marginal teeth multicuspid with ectocone splitting into several minor cusps. Jaw (Fig. 7D,E) with several prominent central ribs, considerably reduced on the side and microscopically, transversely striated. Based on one dissected adult (QMMO56284).

FIG. 7. Shell, jaw and radular details of *Adclarkia dawsonensis* sp. nov., QMMO56284, holotype, Mt Rose Stn. A, apical sculpture. B, pustules and fine ridgelets on body whorl. C, body whorl pustules with periostracal scales. D, jaw. E, microsculpture on ribs of jaw. F,G, central and inner lateral teeth. H, marginal teeth. Scale lines as marked.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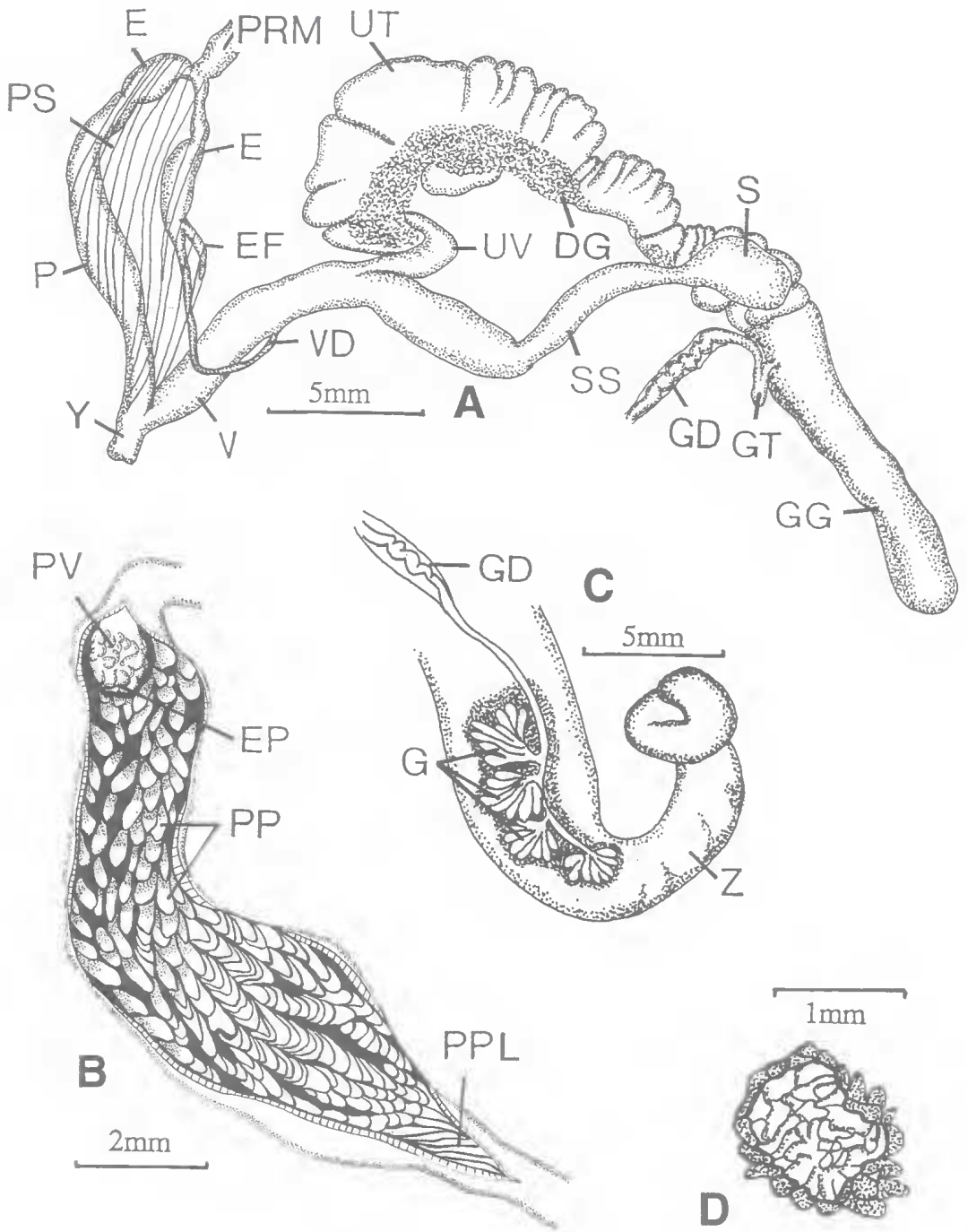

FIG. 8. Reproductive anatomy of *Adclarkia dawsonensis* sp. nov., QMMO56284, holotype, Mt Rose Stn. A, reproductive system. B, penis interior. C, ovotestis. D, head wart. Abbreviations outlined in text. Scale lines as marked.

COMPARATIVE REMARKS. A number of other large camaenids occur in the Dawson Valley. *Sphaerospira nattea* (Iredale, 1933) has a similarly shaped shell but is yellowish-white with several reddish-brown chestnut bands. No surface pustulation is present. The animal is reddish-grey with a red mantle. *Xanthomelon pachystylum* (Pfeiffer, 1845) is much larger than *A.dawsonensis* and has a brownish-yellow, heavy and globose shell without an umbilicus. The animal is light grey in colour and lacks the prominent dark pigmentation of *A. dawsonensis*. However, most confusion is liable to arise through the occurrence of a local, as yet unnamed rhytidid which has a shell of similar size and shape to that of *A.dawsonensis*. This snail is readily recognised by its yellowish, more flattened shell with rather large umbilicus and sculpture of prominent radial ribs.

RANGE AND HABITAT. Taroom to Theodore, in the Dawson Valley. It is a free sealer living in litter and under logs.

REMARKS. Two lots of shells from Theodore (QMMO4239, QMMO6779) have been in the Queensland Museum since the mid-1970's but attempts to find live specimens in the Theodore area have proved fruitless. The thin shell of *A.dawsonensis* indicates that it is not an inhabitant of rock talus but prefers living amongst vegetation and soil (Stanisic pers. obs.). This makes it especially prone to extermination through habitat destruction by fire and land clearing. Considering the degree of habitat modification which has taken place in the Dawson Valley it is possible that the distribution of *A. dawsonensis* is now extremely restricted.

DISCUSSION

The Dawson Valley is depauperate in land snails compared with areas of closed forest further east, yet it would appear that it has played an important part in the past dispersal of terrestrial molluscs now more diverse elsewhere. On the basis of similarities in shell form and reproductive anatomy *E. hewittorum* and *A. dawsonensis* appear related to taxa further south. If this view is supported by much-needed revisionary studies of related taxa in the drier areas of western New South Wales the occurrence of these two species in the Dawson Valley region has interesting biogeographic implications.

Solem (1992b) contended that colonisation of eastern South Australia by the Camaeninae, including *Cupedora*, was from the north through what is now coastal and subcoastal Queensland, and then through New South Wales. Their ancestors came from Papua New Guinea as post-Miocene immigrants (Bishop,1981). Finding a possible relative of this South Australian group of camaenids in the Dawson Valley region lends support to Solem's contention. The thin shell of *A.dawsonensis* would not be unexpected in an ancestor which lived in scattered moist refugia on alluvial flats and along drainage lines. The more complicated penial surface sculpture of *Cupedora* is probably due to sympatric species interactions but nevertheless can be readily derived from the simple pattern of pustules and longitudinal ridges seen in *A. dawsonensis*. *Cupedora* has adapted to living in a restricted moisture regime and is most frequently associated with rocky slopes, crevices and talus. The heavier more robust shell of its members is typical of species with this habitat preference.

E. hewittorum provides additional support for the claim that the Dawson Valley region was an important corridor for snail movement in the past. Apart from the rainforest inhabiting *E. genithecata* there is no other record of the genus in Queensland. Intensive collecting in the Chinchilla area has failed to locate it in that region. This identifies *E. hewittorum* as a northern outlier of a group which has a nearly continuous distribution from northern New South Wales through western Victoria and into eastern South Australia. The Charopidae is a Gondwanan family mainly confined to rainforests (Stanisic, 1990). *Elsothera* is the only group which has managed to diversify into the drier eucalypt forests. Presumably the dispersal was from wetter forests in the east or from ancestors isolated in mesic refugia as rainforests retreated to the coastal mountain ranges. In either case this radiation most probably occurred sometime in the Pliocene when conditions were wetter (Kemp,1981) and were more likely to facilitate the dispersal of these tiny animals. The extensive distribution of the genus suggests an early radiation.The aggressive drying of the Pleistocene (Galloway & Kemp,1981) would have fragmented widespread populations leading to extinctions where mesic refugia did not provide ameliorating microclimates. The close resemblance of *E. hewittorum* to *E. funerea* from northern NSW suggests derivation from a common ancestor and its similarity to *E. nesana* from South Australia attests to the extent of the initial radiation. It is

probably not coincidental that the evolutionary track spanned by these charopids mirrors that of *A. dawsonensis* and *Cupedora*.

Mesic refugia such as those associated with drainage lines in the Dawson Valley have probably played an important part in the endurance of land snails in the region. Their future importance to the survival of wet-adapted biota such as land snails should not be underestimated. The unique, perennially moist boggomosses of Taroom are an integral part of this intricate survival story. It is unlikely that *A. dawsonensis* and *E. hewittorum* are restricted to the boggomoss environment on Mount Rose Stn. *A.dawsonensis* appears to favour drainage lines (Theodore is also on the Dawson River) and is probably spread over the alluvial flats of the Dawson Valley by floods. Following extensive land clearing in the Dawson Valley, opportunistic colonisation of the few remaining mesic refugia such as the boggomosses is now probably an essential part of the long term viability of this species. The single occurrence of *E. hewittorum* makes any speculation about survival in preferred habitat less informative, however, the same general principles of dispersal and colonisation would apply.

The boggomosses, particularly those with structured vegetation communities, form an important part of the scattered archipelago of mesic refugia in the Dawson Valley. Considering the damage which has been caused to these habitats in the past, by both stock and fire, it will be necessary to implement more sympathetic management practices in the future to ensure their continued existence and the survival of the biota which they support.

ACKNOWLEDGEMENTS

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